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UPGRADING MEDIUM QUALITY COAL MINE GAS BY BLENDING AND SPIKING

Typical pipeline equipment required for blending coal mine gas with higher heating value gas

BLENDING AND SPIKING ARE COST EFFECTIVE APPROACHES TO MEETING PIPELINE SPECIFICATIONS BECAUSE…

- These processes blend gob gas or other "below spec" coal mine gas with high heating value gas from pre-drainage wells, conventional natural gas, or propane
- They can be used either as stand-alone processes or in conjunction with enrichment
- They are proven processes in both the conventional natural gas and coal mine methane industries
- Upgrading helps increase the use of coal mine methane, which reduces greenhouse gas emissions

Spiking and blending can be inexpensive techniques for upgrading gob gas

Why Consider Spiking and Blending to Produce Pipeline Quality Coal Mine Gas?

A large portion of the methane emitted from coal mines comes from gob areas (collapsed roof rock over the mined out coal), where methane concentrations typically vary from 30 to 80%. For safety reasons, many mines drain gob gas, but often do not use it because pipelines typically require gas whose methane content is at least 95% (about 950 btu/ft^3). In some cases, however, medium-heating value coal mine gas can be blended with higher heating value gas and/or spiked with propane to produce marketable pipeline quality gas.

Blending is the process of mixing medium heating value gas with high heating value gas (blending gas) to achieve a blended gas that meets or exceeds minimum pipeline quality requirements. Spiking is the process of adding propane in order to boost the heating value up to pipeline quality. Spiking and blending, together with careful gob well monitoring, can result in pipeline quality gas that can be sold to consumers. In some cases, spiking and blending can cost-effectively supplement enrichment processes such as nitrogen and carbon dioxide rejection.

Spiking and blending do not require a gas processing facility

At least two coal mine methane project developers in the United States use blending and/or spiking to improve the quality of the gas they produce. The Noumenon Corporation of Core, West Virginia, is blending gas from West Virginia mines with high-Btu gas or propane and selling the product to several utilities. Stroud Oil Properties, Inc. blends coal mine gas from the abandoned Golden Eagle Mine in Colorado with coalbed methane that has a heating value of about 980 Btu, produced from a nearby field. Stroud sells the blended gas to the local pipeline.

The quality of both the gob gas (or other "off-spec" gas) and the blending gas impact the feasibility of spiking and blending. Gas whose methane concentration exceeds 60% and whose oxygen concentration is less than 5% is most suitable for spiking and blending. Spiking and blending may work well with a broader, integrated strategy that includes improving gas recovery systems to enhance gas quality, and/or gas enrichment to remove contaminants such as nitrogen, oxygen, carbon dioxide, and water vapor.

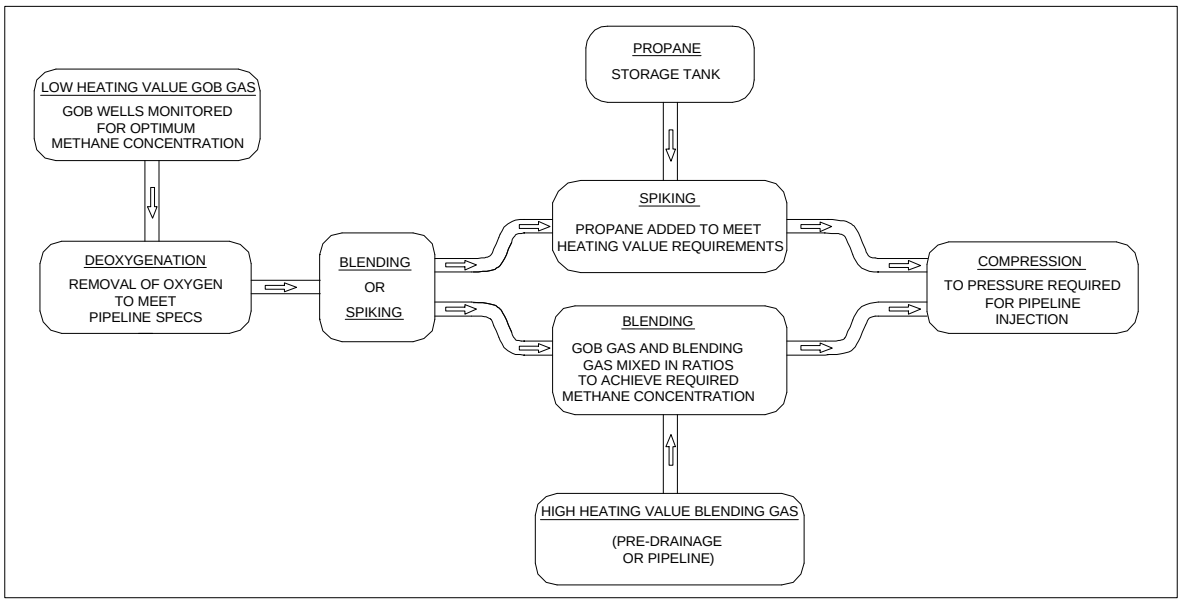
U.S. EPA has developed software to help developers determine cost-effective

Under ideal circumstances, blending or spiking alone may dilute the contaminants in gob gas sufficiently to meet pipeline specifications. Often, however, it is necessary to remove water, moisture, and oxygen. The most expensive part of this treatment is deoxygenation, the capital cost of which is typically more than $450,000 to treat a 3 mmcf/d gob gas flow containing about 3% oxygen. Water separation and dehydration may each cost about $20-25,000 for similar gob gas flow

rates. Despite these costs, projects that require gas cleanup prior to blending or spiking can still be economic.

Project costs and revenues vary widely depending on site specific conditions. U.S. EPA has prepared a computer model that helps gas project developers identify cost-effective combinations of enrichment, blending, and spiking options. The following page includes sample model inputs and outputs.

SPIKING AND BLENDING PROCESS



Sample Economics from the U.S. EPA Gas Upgrade Model

The model employs conservative capital and operating cost estimates for all parameters, including gas compression and enrichment. The table below shows sample model inputs and outputs for varying gob gas methane concentrations, and varying blending gas costs and propane prices. For this illustration, each case assumes that the total flow rate of gas (both high-heating value and gob) that can be drained from the mine is 10 mmcf/d, and that the pipeline requires 96% methane and no more than 4% inert gases. This illustration also assumes that there is sufficient high-quality coal mine gas recovered from the mine to use as blending gas, rather than purchasing natural gas.

In Case 1, the mine could upgrade its gas for $1.54/mmbtu using enrichment only, or for $1.48/mmbtu if it subsequently blended the enriched gob gas with high-heating value coal mine gas. If the mine were able to sell the gas at $2.00/mmbtu, it would net $0.46/mmbtu using enrichment only, and $0.52/mmbtu using a combination of enrichment and blending. In Case 2, enrichment followed by spiking would be the most profitable option, while in Case 3, enrichment alone would be most profitable.

Case	Inputs to Model					Outputs from Model (Cost to Upgrade in $/Mmbtu)		
	% Gob Gas	% Blending Gas	% of Methane in Gob Gas	Cost of Blending Gas[1] ($/mmbtu)	Cost of Propane ($/mmbtu)	Enrichment Only ($/mmbtu)	Enrichment Followed by Blending ($/mmbtu)	Enrichment Followed by Spiking ($/mmbtu)
1	32	68	82	$1.60	$4.10	$1.54	**$1.48**	$1.53
2	30	70	85	$1.75	$3.75	$1.50	$1.50	**1.47**
3	42	58	83	$1.70	$4.25	**$1.39**	N/A	N/A

[1] "Cost of blending gas" is the value of the high-heating value gas used for blending, i.e., the price at which the gas could be sold to a pipeline minus the assumed cost of compressing and transporting the gas to the pipeline

N/A = Value Not Available; if the model determines that enrichment only (i.e., not followed by blending or spiking) is the cheapest option (Case 3), it does not reveal the cost to blend or spike.

It is important to recognize that the above cases are illustrative only, and that a margin of error is inherent in the model. The model is designed for preliminary analysis only, and model users will need to conduct further technical and economic analyses before undertaking a project.

For More Information...

U.S. EPA's 1997 report, *Technical and Economic Assessment of Potential to Upgrade Gob Gas to Pipeline Quality*, and accompanying computer model examine various options for upgrading medium quality coal mine gas. To obtain the computer program and report, contact:

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